FIG. 1

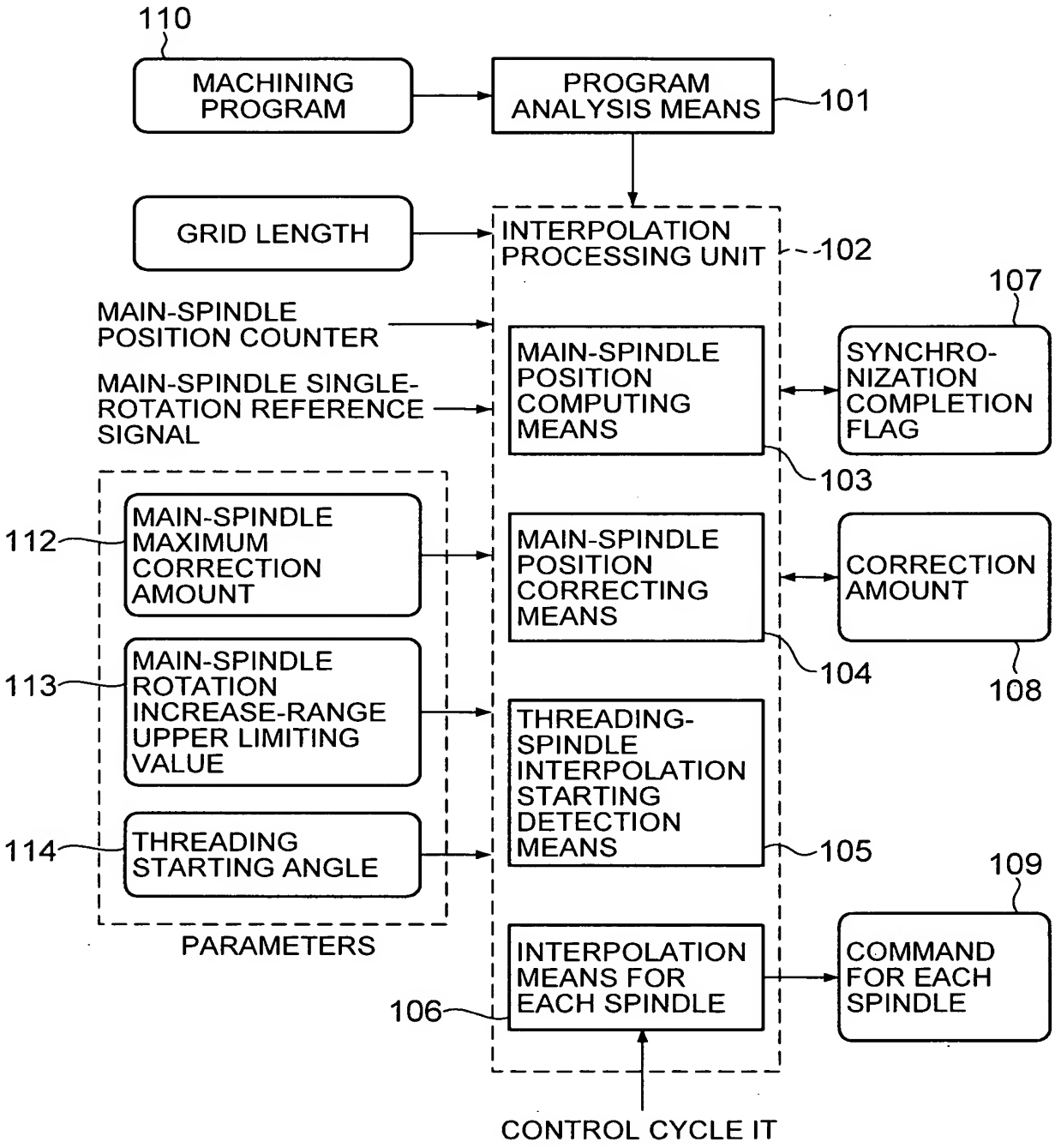

110
MACHINING PROGRAM
PROGRAM ANALYSIS MEANS
101
GRID LENGTH
INTERPOLATION PROCESSING UNIT
102
107
MAIN-SPINDLE POSITION COUNTER
MAIN-SPINDLE SINGLE-ROTATION REFERENCE SIGNAL
MAIN-SPINDLE POSITION COMPUTING MEANS
SYNCHRO-NIZATION COMPLETION FLAG
103
112
MAIN-SPINDLE MAXIMUM CORRECTION AMOUNT
MAIN-SPINDLE POSITION CORRECTING MEANS
CORRECTION AMOUNT
104
108
113
MAIN-SPINDLE ROTATION INCREASE-RANGE UPPER LIMITING VALUE
THREADING-SPINDLE INTERPOLATION STARTING DETECTION MEANS
105
114
THREADING STARTING ANGLE
109
PARAMETERS
INTERPOLATION MEANS FOR EACH SPINDLE
COMMAND FOR EACH SPINDLE
106
CONTROL CYCLE IT

FIG. 2

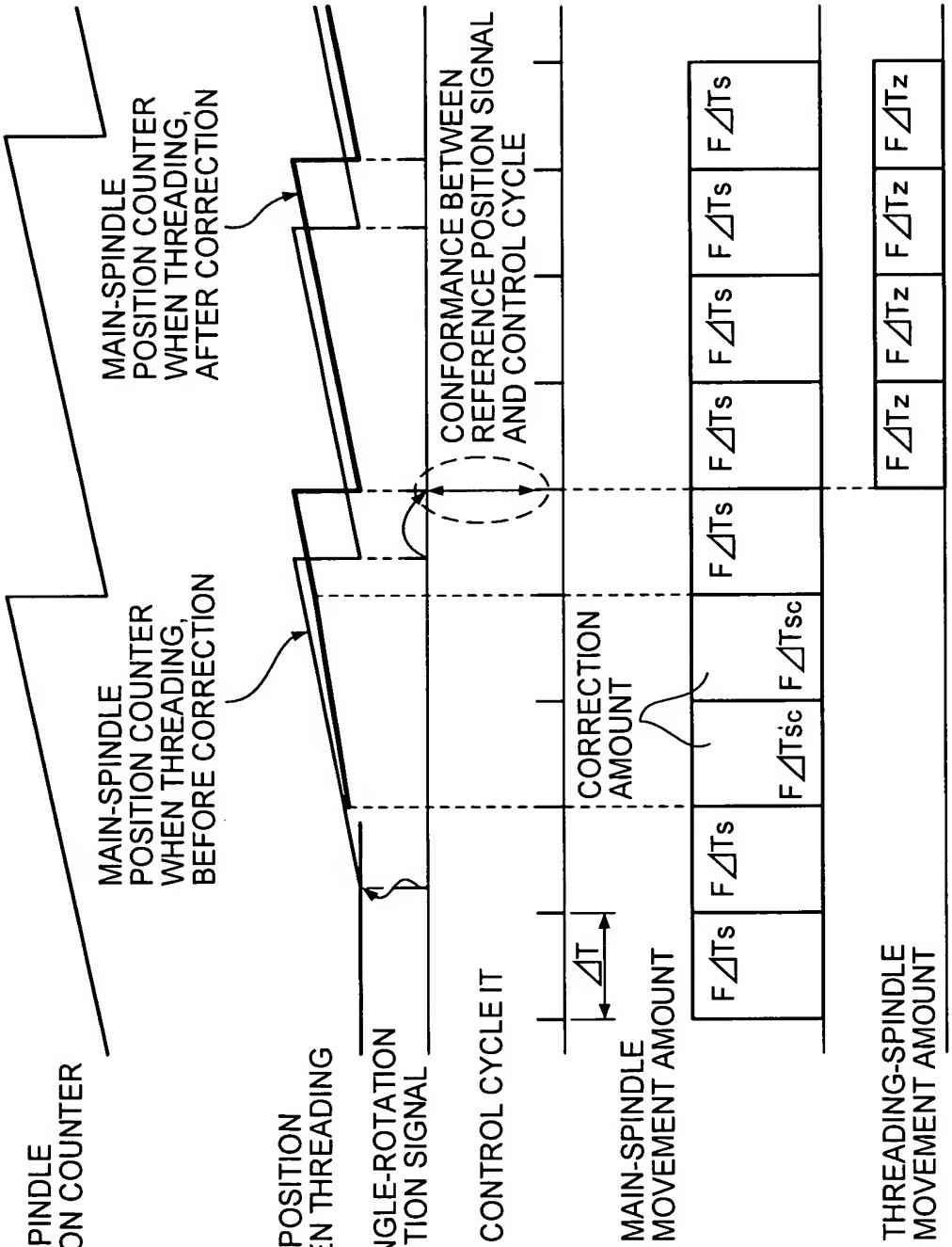
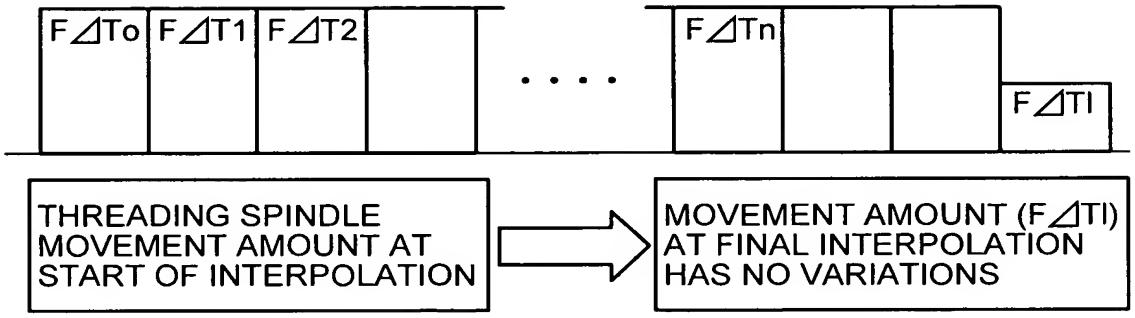

MAIN-SPINDLE POSITION COUNTER
MAIN-SPINDLE POSITION COUNTER WHEN THREADING, BEFORE CORRECTION
MAIN-SPINDLE POSITION COUNTER WHEN THREADING, AFTER CORRECTION
MAIN-SPINDLE SINGLE-ROTATION REFERENCE POSITION SIGNAL
CONFORMANCE BETWEEN REFERENCE POSITION SIGNAL AND CONTROL CYCLE
CONTROL CYCLE IT
ΔT
CORRECTION AMOUNT
MAIN-SPINDLE MOVEMENT AMOUNT
F·ΔTs
F·ΔTs
F·ΔTs
F·ΔTs
F·ΔTs
F·ΔTs
F·ΔTs
F·ΔTsc
F·ΔTsc
F·ΔTz
F·ΔTz
F·ΔTz
F·ΔTz
THREADING-SPINDLE MOVEMENT AMOUNT

FIG. 3



F⊿Ts :MAIN-SPINDLE MOVEMENT AMOUNT PER CONTROL CYCLE
F⊿Tsc:POST-CORRECTION MAIN-SPINDLE MOVEMENT AMOUNT PER CONTROL CYCLE
F⊿Tz:THREADING-SPINDLE MOVEMENT AMOUNT PER CONTROL CYCLE
F⊿To:THREADING-SPINDLE MOVEMENT AMOUNT AT FIRST INTERPOLATION
F⊿Tn:THREADING-SPINDLE MOVEMENT AMOUNT AT SECOND AND SUBSEQUENT INTERPOLATIONS
F⊿TI:THREADING-SPINDLE MOVEMENT AMOUNT AT FINAL INTERPOLATION
⊿T:CONTROL CYCLE

FIG. 4

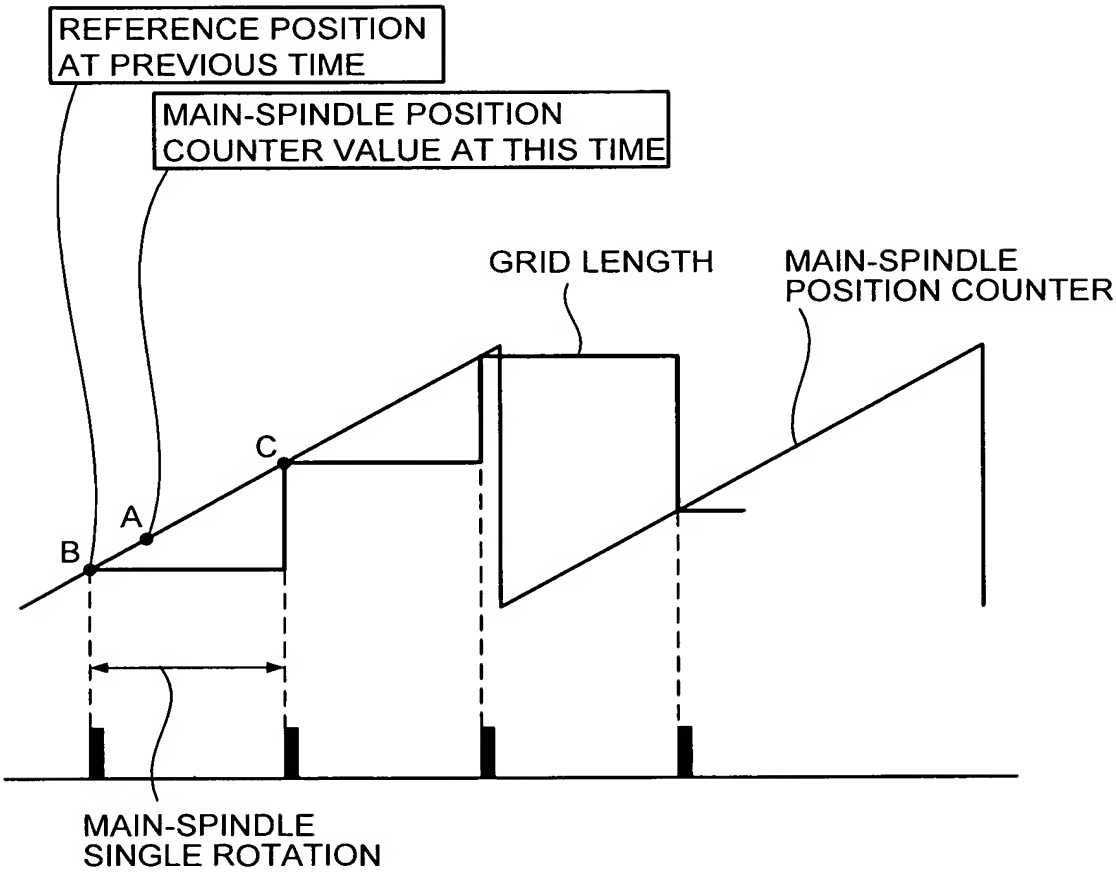

REFERENCE POSITION AT PREVIOUS TIME
MAIN-SPINDLE POSITION COUNTER VALUE AT THIS TIME
GRID LENGTH
MAIN-SPINDLE POSITION COUNTER
A
B
C
MAIN-SPINDLE SINGLE ROTATION

FIG. 5

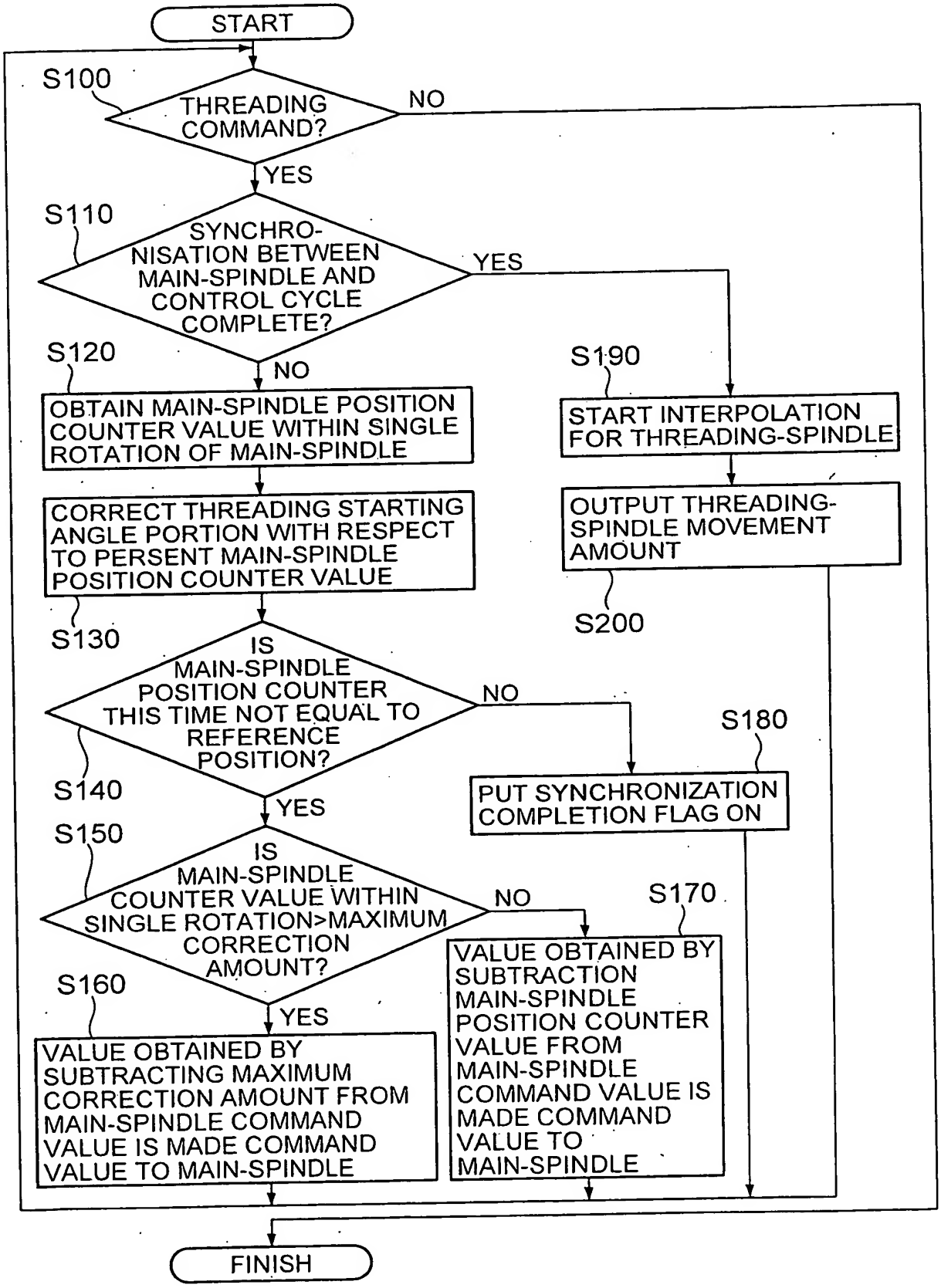
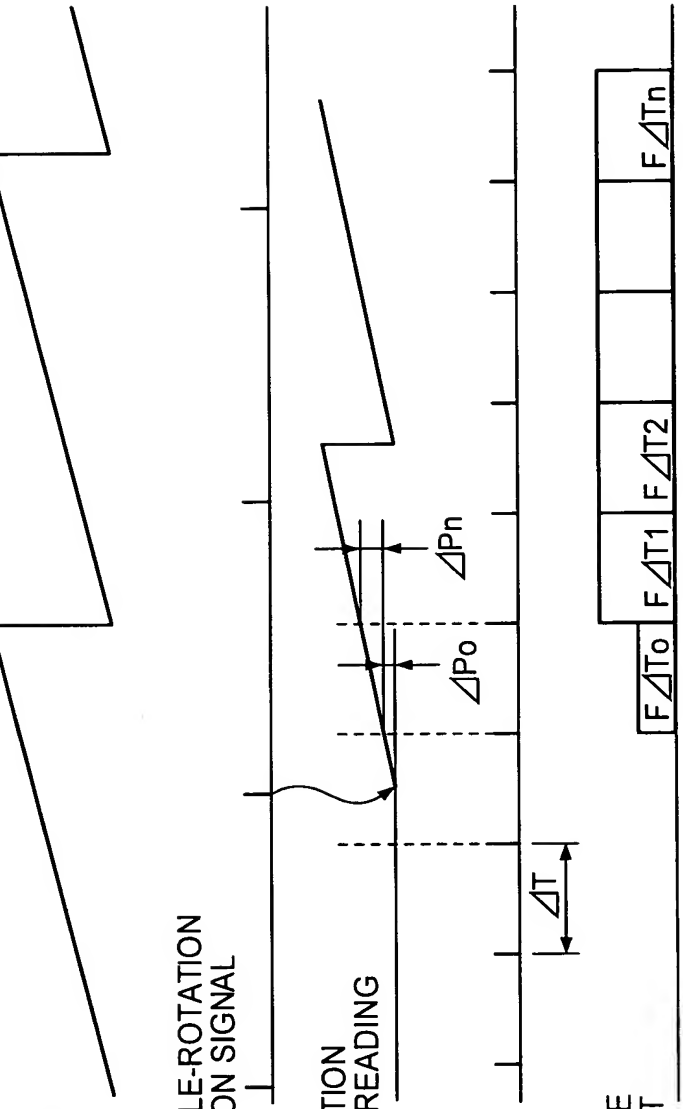

START
S100
THREADING COMMAND?
NO
YES
S110
SYNCHRO-NISATION BETWEEN MAIN-SPINDLE AND CONTROL CYCLE COMPLETE?
YES
NO
S120
OBTAIN MAIN-SPINDLE POSITION COUNTER VALUE WITHIN SINGLE ROTATION OF MAIN-SPINDLE
CORRECT THREADING STARTING ANGLE PORTION WITH RESPECT TO PERSENT MAIN-SPINDLE POSITION COUNTER VALUE
S130
IS MAIN-SPINDLE POSITION COUNTER THIS TIME NOT EQUAL TO REFERENCE POSITION?
NO
YES
S140
S150
IS MAIN-SPINDLE COUNTER VALUE WITHIN SINGLE ROTATION>MAXIMUM CORRECTION AMOUNT?
NO
YES
S160
VALUE OBTAINED BY SUBTRACTING MAXIMUM CORRECTION AMOUNT FROM MAIN-SPINDLE COMMAND VALUE IS MADE COMMAND VALUE TO MAIN-SPINDLE
S170
VALUE OBTAINED BY SUBTRACTION MAIN-SPINDLE POSITION COUNTER VALUE FROM MAIN-SPINDLE COMMAND VALUE IS MADE COMMAND VALUE TO MAIN-SPINDLE
S180
PUT SYNCHRONIZATION COMPLETION FLAG ON
S190
START INTERPOLATION FOR THREADING-SPINDLE
OUTPUT THREADING-SPINDLE MOVEMENT AMOUNT
S200
FINISH

FIG. 6



$F\Delta To = (\Delta Po \div P) \times L$
$F\Delta To = (\Delta Pn \div P) \times L$
$F\Delta To$: THREADING-SPINDLE MOVEMENT AMOUNT AT FIRST INTERPOLATION
$F\Delta Tn$: THREADING-SPINDLE MOVEMENT AMOUNT AT SECOND AND SUBSEQUENT INTERPOLATIONS
ΔT : CONTROL CYCLE
ΔPo : FIRST MAIN-SPINDLE POSITION CHANGE AMOUNT (NUMBER OF PULSES)
ΔPn : SECOND AND SUBSEQUENT MAIN-SPINDLE POSITION CHANGE AMOUNTS (NUMBER OF PULSES)
P : NUMBER OF PULSES PER SINGLE MAIN-SPINDLE ROTATION
L : THREAD LEAD

FIG. 7

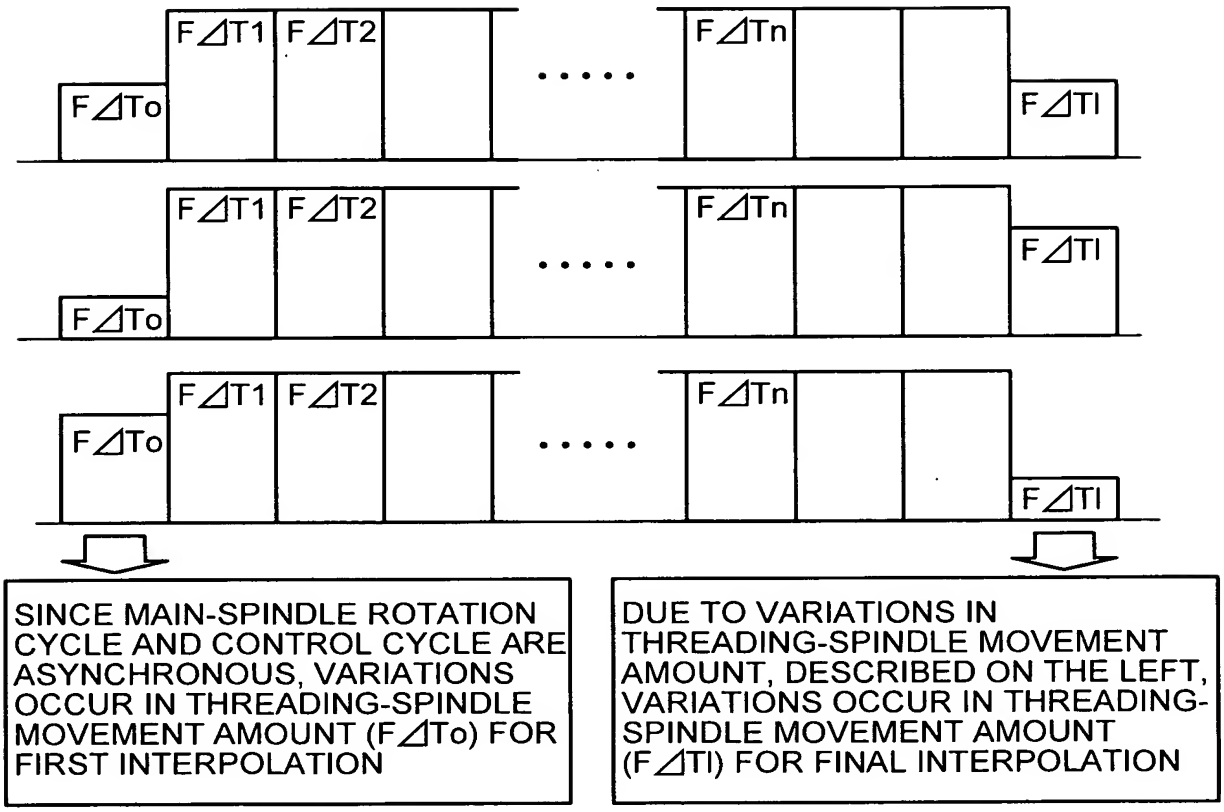
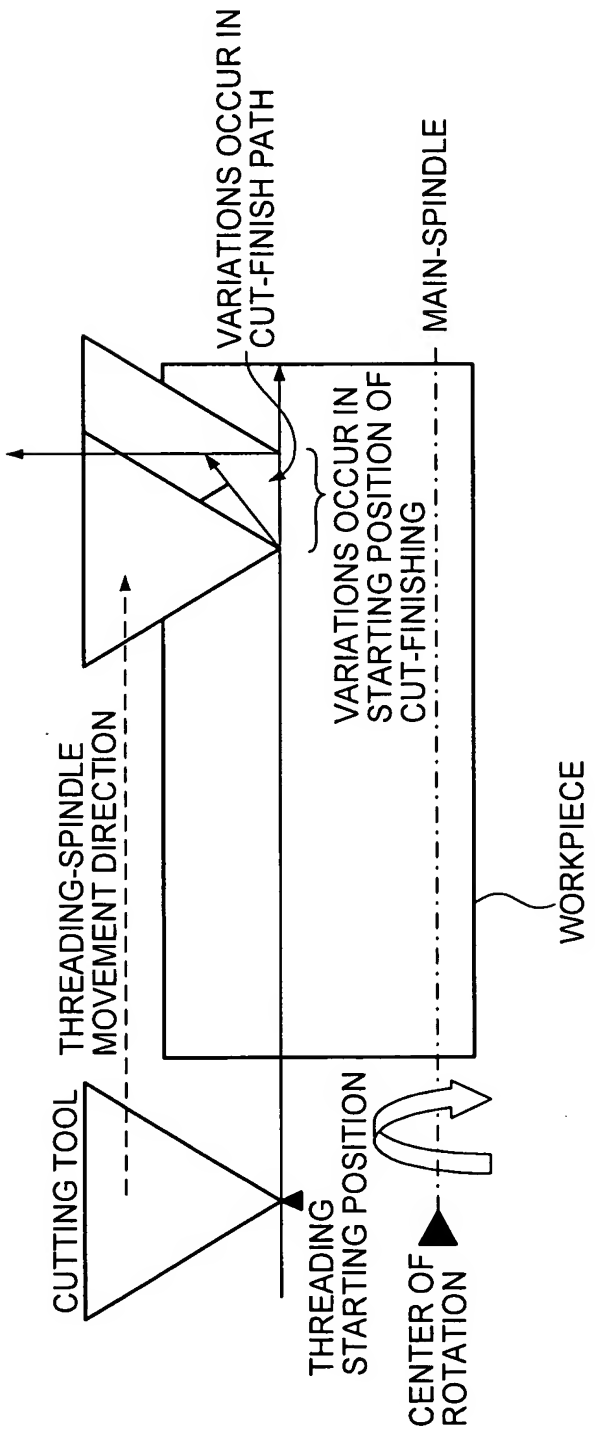

FΔTo
FΔT1
FΔT2
FΔTn
FΔTl
SINCE MAIN-SPINDLE ROTATION CYCLE AND CONTROL CYCLE ARE ASYNCHRONOUS, VARIATIONS OCCUR IN THREADING-SPINDLE MOVEMENT AMOUNT (FΔTo) FOR FIRST INTERPOLATION
DUE TO VARIATIONS IN THREADING-SPINDLE MOVEMENT AMOUNT, DESCRIBED ON THE LEFT, VARIATIONS OCCUR IN THREADING-SPINDLE MOVEMENT AMOUNT (FΔTl) FOR FINAL INTERPOLATION

FIG. 8


VARIATIONS OCCUR IN CUT-FINISH PATH
MAIN-SPINDLE
VARIATIONS OCCUR IN STARTING POSITION OF CUT-FINISHING
THREADING-SPINDLE MOVEMENT DIRECTION
WORKPIECE
CUTTING TOOL
THREADING STARTING POSITION
CENTER OF ROTATION